integral dose to bone would be from two to four times greater in children than in adults purely as a result of the higher concentration of the radioactive dose in the smaller juvenile skeleton. It is possible that the higher rate of remodelling in the youthful skeleton as compared with the adult would contribute to a higher rate of removal of the radioactive dose in children.

Summary

The daily urinary and faecal excretion of strontium and calcium for four children between the ages of 4½ and 14½ years has been measured over an initial period of seven or eight consecutive days immediately before an oral dose of about 100 mg. of strontium (as strontium chloride) taken at breakfast-time. Subsequently, the daily urine and faecal excretion of strontium and calcium was estimated over a period of from 12 to 18 days and the net retention of the dose deduced. The results are compared with the excretion of an oral dose of strontium by adults from this unit.

The mean, cumulative, urinary excretion of a single oral dose of strontium was about 3% for the children up to 16 days after the dose, with the exception of a boy 14½ years old. The corresponding faecal excretion was about 78% of the dose. The respective excretions, over a similar period, for adults were 19% and 64% of the dose. Thus the retention (dose-excretion) up to 16 days after the dose was not significantly different in the two age-groups.

An attempt made to compare values derived for the overall discrimination of strontium relative to calcium in children and adults tends to show that it is rather higher in children.

Our thanks are due to Drs. J. F. Loutit and R. H. Mole for their continued interest and most helpful advice in the course of this work.

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HAEMOPTYSIS

BY

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For most patients and not a few doctors, the expectoration of blood signals either pulmonary tuberculosis or carcinoma. We have been impressed by the number of patients with haemoptysis in whom neither of these conditions was present. A reassessment of this symptom is necessary, particularly since the pattern of respiratory disease has been changing during the past ten years.

Our purposes therefore were: (1) to examine the causes of haemoptysis in chest-clinic practice; (2) to consider whether there are features of the haemoptysis peculiar to different diseases; and (3) to determine the need for follow-up of patients presenting with haemoptysis without apparent cause.

Material and Methods

Haemoptysis is defined here as the expectoration of blood or blood-stained mucus not due to bleeding in the upper respiratory tract or associated with gastrointestinal bleeding. We recognized that often there was no immediate confirmation of the bleeding, and it was unusual for the patient to be able to produce blood-stained sputum on request. We depended on the patient's account of this bleeding episode, on the observations made by his own general practitioner, and on such further details as we could elicit on close questioning. To facilitate the last, the accompanying form was designed, since we could not hope to find the details required from all patients in any analysis of previous records. A little experience shows that there is

Date of first attendance:

INVESTIGATION OF CASES OF HAEMOPTYSIS

Patient's Name Ref. No.

Details concerning the haemoptysis

1. (a) Doubtful:
- (b) Probable:
- (c) Certain:
2. Any associated upper respiratory bleeding:
3. Any history of acute upper respiratory infection:
4. Estimate of the amount of blood expectorated:
5. A frank haemoptysis or merely staining:
6. Single or repeated haemoptysis:
7. Can the patient locate the site of the haemoptysis?
8. Duration of the haemoptysis:
9. Any other bleeding tendency:
10. Smoking history:

Clinical findings

1. U.R.T.
2. B.P.
3. Heart:
4. ? Added sounds in the chest:
5. X ray of chest:
6. Predominant pathogens in the sputum:
7. Cultures for *M. tuberculosis*:

Diagnosis

sometimes doubt concerning the origin of the blood. Patients in whom there was either preceding nose- or mouth-bleeding or vomiting were excluded. We separated patients with a history of haemoptysis into the following categories:

Doubtful.—Referred by the general practitioner as "haemoptysis," but the patient was vague about details and was regarded as a poor witness, or further questioning revealed bleeding of the upper respiratory tract about the time of the haemoptysis (but *not* immediately preceding it).

Certain.—Close questioning confirmed the general practitioner's opinion that this was a true haemoptysis. In some cases there was confirmation from the family about the bleeding.

Probable.—Intermediate between the two above.

The remainder of the form is self-explanatory with the following exceptions.—We defined *single* haemoptysis as an episode lasting up to seven days but usually only one to two days, and *repeated* where the bleeding continued longer than seven days or there was a break in continuity of at least two to three days—that is, more than one episode of bleeding. *Frank* haemoptysis denoted the expectoration of pure blood, without sputum.

Routine clinical examination (including blood-pressure) was supplemented by a full-size postero-anterior film of the chest and examination of the sputum (if available) for predominant organisms and *Mycobacterium tuberculosis*. Where there was no sputum and the x-ray film was normal, no bacteriological examination was carried out. If the x-ray film was abnormal, laryngeal swabs were taken. Sputum cytology was not investigated. While it may be a counsel of perfection to offer bronchoscopy and bronchography to all who complain of haemoptysis, it is doubtful whether this is justified. Bronchoscopy and bronchography were therefore recommended only if the haemoptysis was thought to be certain and was repeated. Where the initial investigations pointed to bronchial carcinoma the patient was referred to the thoracic surgeon. For those in whom the chest x-ray film was normal the investigations were completed by ourselves.

Follow-up assessment, which included a further P.A. film of the chest, was arranged three months, six months, one year, and two years after the first attendance. It was essential that our follow-up be as complete as possible, since this had not been achieved in previous reports. When the usual appointment notes failed, a personal letter was written to the patient, and, if this failed, his doctor was approached. If the doctor was unable to help, the health visitor, and then one of us, visited the home and repeated the visits until we were satisfied that these were fruitless.

Results

During 1956 2,187 new patients attended the chest clinic, of whom 324 (15%) gave a history of haemoptysis within the preceding month. The monthly incidence varied from a peak of 30% in February to 8% in July. The February increase was related to a higher proportion of bronchiectasis, pneumonia, and pulmonary tuberculosis.

The patients were predominantly young, with the peak incidence in the third decade (82 patients), but the age distribution covered eight decades (9 were aged 10 years or less and 13 were 70 or more). There were rather more males than females (182/142).

The haemoptyses were classified as follows: doubtful, 48 (15%); probable, 90 (28%); certain 186 (57%).

The total amount of blood expectorated was assessed as follows: Streaking only, 155; more than streaking but less than 5 ml., 95; exceeding 5 ml. but less than 30 ml., 45; exceeding 30 ml., 16; doubtful or not stated at first interview, 13. (Four patients gave a history of large haemoptyses exceeding 300 ml.)

The x-ray film of the chest was normal in 168, while in a further 26 the only abnormalities were calcified primary foci (parenchymal scars and/or calcified hilar nodes). We noted that such calcified primary lesions were relatively common. To test the significance of this finding we re-examined the radiographs of all those patients in whom either no abnormality could be found (N.A.D. group) or, at the most, only upper respiratory infection (U.R.I. group)—a total of 145 patients. Twenty-six (18%) showed calcified primary foci (calcified apical lesions were excluded and hilar calcification accepted only if the shadow appeared "craggy" and irregular). A control group was obtained by reviewing the first 200 attendances during the same year in which the diagnosis of N.A.D. or U.R.I. and the age-and-sex distribution approximated, but in which there was no history of haemoptysis. Ten were excluded because re-scrutiny of the x-ray film raised doubts whether it was normal. The results of this comparison are shown in Table I. The incidence of calcified primaries was higher in those with haemoptysis, and the observed difference (8.6%) is more than twice the standard error of the difference between the two proportions (3.7%). These calcified primaries have not altered on subsequent radiographs, nor was there any record of a broncholith being expectorated. In those with calcified hilar nodes we have been unable, at bronchoscopy, to see any abnormality of the mucosa overlying the calcified area. Of the 53 patients who had bronchograms, 11 had calcified primary complexes or calcified hilar nodes, but only two had demonstrable bronchiectasis in relation to these areas of calcification.

Sputum studies for predominant organisms in 96 patients revealed no uniform pathogen—a mixture of pneumococci, *Haemophilus influenzae*, *Streptococcus viridans*, *Staphylococcus aureus* and *albus*, diphtheroids, and the occasional Friedländer bacillus, and yeasts. On average, two cultures for *M. tuberculosis* were obtained from 173 patients, and in only 14 patients were positive cultures isolated. In no instance were tubercle bacilli discovered without a radiological lesion.

Bronchoscopy was done under local anaesthesia in 51 patients. The straight and right-angle telescopes were used to obtain a systematic view of as many of the segmental orifices as possible. Biopsy was taken only if there was a local lesion. Apart from bronchial carcinoma, the only other abnormalities were the mucosal changes of chronic bronchitis.

Bronchograms were obtained in 53 patients, using aqueous propylidone. Complete filling of all the

TABLE I.—*Relation Between Haemoptysis and X-ray Evidence of Calcification*

	No. of Patients	Calcified Scars or Calcified Hilar Nodes
Haemoptysis (N.A.D. + U.R.I.) ..	145	26 (18%)
Control " " " " ..	190	18 (9%)

Observed difference, 8.6%; S.E. 3.7%.

segmental branches in both lungs was achieved except in the elderly with limited respiratory function.

Diagnosis

The final diagnoses are listed in Table II. As some patients had more than one diagnosis the total in this table exceeds 324.

TABLE II.—*Diagnoses in 324 Patients with Haemoptysis*

Upper respiratory infection	..	..	..	77
N.A.D.	..	..	..	68
Bronchitis	..	..	..	56
Bronchiectasis	..	..	..	43
Pulmonary tuberculosis	{ Active	..	..	14
	{ Quiescent	..	..	18
Pneumonia	..	..	..	20
Cardiovascular disease	{ Essential hypertension (diastolic > 100 mm.)	..	..	16
	{ Mitral valvular disease	..	..	7
Carcinoma	..	..	..	14
Others	..	..	..	4

The pneumonias were all of less than lobar extent and usually segmental as judged by the radiographs. Bronchitis, with the exception of three acute forms, was chronic—defined here as a history of productive cough over at least two years and associated with some disability, either dyspnoea or a record of time lost from work owing to "bronchitis." The diagnosis of bronchiectasis was confirmed in less than half the cases because we reserved bronchoscopy and bronchograms for patients with repeated haemoptysis, and bronchography for those in whom we considered confirmation of the diagnosis would determine the line of treatment. Of the cases of active pulmonary tuberculosis seven were minimal and seven moderately advanced. *M. tuberculosis* was recovered from all these patients.

The low incidence of carcinoma and active pulmonary tuberculosis in this series as cause of haemoptysis (each only 4%) is notable. No bronchial adenoma was discovered. Cardiovascular disease was infrequent, but was an expected finding, as patients with known cardiac disease were generally referred to the cardiac clinic or the out-patient department of a general hospital. No pulmonary infarct was found.

Only 16 patients had systemic hypertension, defined here as a diastolic reading exceeding 100 mm. Hg. The incidence in the group as a whole is therefore low (5%). There was no recurrence of the haemoptysis in these patients despite a rising diastolic pressure in two (140 mm. in one and 160 mm. in the other); further, no other bleeding tendency was detected.

Character of Haemoptyses in Relation to the Cause

We have analysed the type, duration, and sequence of bleeding and can recognize minor differences in bronchial carcinoma, active pulmonary tuberculosis, and bronchiectasis (Table III). The haemoptysis of active tuberculosis and bronchiectasis tended to be brisk and of short duration, while that of carcinoma was more prolonged. In 3 of the 14 carcinoma cases the haemoptysis was *not* defined as "certain." In chronic bronchitis there was no distinctive pattern; usually the haemoptysis was "certain," a single episode with only streaking of the sputum. A frank haemoptysis was uncommon (only 10 patients).

TABLE III.—*Haemoptysis Pattern*

	Carcinoma (14 Patients)	A.P.T. (14 Patients)	Bronchiectasis (17 Patients)
"Certain" ..	11	13	15
"Streaking" ..	10	3	10
"Frank" ..	2	8	8
"Repeated" ..	9	7	11
Duration ..	10 = 2 weeks or longer	10 = 1 week or less	12 = 3 days or less

Follow-up

Over a two-year period 20 patients died, 14 from cancer of the lung and 6 from cardiovascular disease. Only one of these died during a further haemoptysis. Of the remaining 304 patients, 279 (91.8%) have been examined one year and 273 (89.8%) two years after their first attendance. Of the 31 who were not examined at the end of two years, 10 have been interviewed and appear well and are working but have refused further x-ray examination. Of the remaining 21, 16 have left the city, four cannot be traced, while one elderly lady is confined to bed at home with "bronchitis." In 18 of the 273 patients the final x-ray film of the chest at two years was not a full-size P.A. film but a 35-mm. M.M.R. film taken during the 1958 M.M.R. campaign. We have re-scrutinized these M.M.R. films and are satisfied that they are normal.

At the final review several patients denied the history of blood expectoration given at their first visit; consciously or unconsciously, they contradicted their original history. This amnesia underlines the need for careful recording at the first visit and is a reminder of the limitations of the retrospective survey.

In the course of the follow-up the diagnosis was eventually confirmed in one and corrected in three other patients.

A man aged 47 with a history of certain and repeated haemoptysis and a suspicious left hilar shadow. He refused investigation but 11 months later agreed, and was found to have a squamous carcinoma of bronchus which was inoperable.

A man aged 67 whose initial assessment was "chronic bronchitis." Bronchogram showed a segmental filling defect, considered at the time to be due to inadequate filling. Reinvestigation three months later because of a recurrence of his haemoptysis revealed a squamous carcinoma of the bronchus, for which left pneumonectomy was performed.

A man aged 39 was initially assessed as "minimal observation pulmonary tubercle" and kept under review. Three months after haemoptysis this lesion cavitated, with a minimal spread and sputum positive for *M. tuberculosis*.

A woman aged 20 was a contact of known pulmonary tuberculosis. X-ray film at time of haemoptysis was considered normal, an opinion confirmed on re-scrutiny. She was kept under review, and 10 months later developed a minimal focus in the right upper zone, with sputum positive for *M. tuberculosis*.

Discussion

Chronic bronchitis is certainly an important cause of haemoptysis, and, in view of the bronchoscopic appearances in this disease, blood-staining of the sputum is not surprising. Smidt (1957) has described "sites of predilection" for haemoptyses—the areas around the orifices of the upper-lobe bronchi. These areas, however, can usually be examined more systematically than the lower bronchi. Though small bleeding-points were often noted in our bronchitic patients, we observed no special localization, but in some of the patients slight pressure from the top of the bronchoscope caused a small bleeding-point. It is probable that acute paroxysms of coughing can cause bleeding of the congested and inflamed mucosa of the bronchitic. We believe that this is an important cause of haemoptysis at the present time.

Of the 177 new notifications of active pulmonary tuberculosis in 1956, only 14 (8%) presented with haemoptysis, a lower proportion than reported by any

previous authors. In part, this is due to an increasing proportion of minimal lesions and fewer with moderately or far-advanced disease, but half of our patients were already moderately advanced. Comparison of the pattern of haemoptysis showed curiously larger amounts of blood recorded by those with minimal disease (six out of seven patients had noted 5 ml. or more of blood, compared with three out of seven with moderately advanced disease). But those with cavitary disease recorded a *repeated* haemoptysis in six out of seven, compared with only three out of seven with minimal disease. Apart from these differences, we could determine no other feature peculiar to haemoptysis in active pulmonary tuberculosis. Only one of these patients presented with a normal x-ray picture. She was a young woman aged 20 who was already attending the contact clinic. Her minimal lesion came to light 10 months after her haemoptysis and would, in any case, have been discovered.

Among those with quiescent pulmonary tuberculosis the haemoptysis was usually a single episode with only streaking of the sputum. In none of these patients was there any late reactivation of their tuberculous foci and, indeed, the haemoptysis was probably coincidental.

The character and degree of bleeding among our patients with bronchiectasis approximated to the pattern, for patients with active pulmonary tuberculosis. There was no difference between patients with cylindrical (8) or saccular (9) bronchiectasis.

In bronchial carcinoma the notable feature of the haemoptysis was its *duration*, which in the majority was at least two weeks. During this same year we saw 26 new patients with bronchial carcinoma, of whom 14 had haemoptysis. In 13 of these 14 patients a tumour was seen at bronchoscopy, and in 11 there was histological proof (seven squamous cell, one adenocarcinoma, and three anaplastic). These numbers were too small to recognize differences in the history of haemoptysis.

The problem of the patient with haemoptysis and a normal x-ray picture of the chest has been discussed by Mitchell (1955), who, among 30 such patients, found four with proved carcinoma and another two probable. Somner *et al.* (1958) report 93 patients, five of whom had bronchogenic carcinoma, and they note that these tumours all came from the 55 patients over the age of 40. Including 26 with calcified primary foci, 194 of our patients had a normal x-ray picture of the chest and only three of these were found to have a bronchial carcinoma (two proved, and one probable in an elderly patient who died at home). These three patients were men over the age of 40. The likelihood of carcinoma in a man over the age of 40 with an x-ray picture of the chest which shows nothing abnormal is therefore probably no higher than one in eight. We agree, however, with Somner *et al.* (1958) that bronchoscopy is advisable in men over 40 with a record of haemoptysis, even though their chest radiographs are normal.

At the start of this survey we felt that some follow-up of patients with haemoptysis was necessary, but it was a matter of conjecture how long this should be. We believed then that a year was necessary and two years desirable. The evidence we have accumulated from this series of patients shows that follow-up is not necessary.

Conclusions

Among 324 patients with haemoptysis we have been unable to find a cause in 145 (44%). Inflammatory conditions of the bronchi, chronic bronchitis, and

bronchiectasis accounted for 30% of the total and were more than seven times as frequent as either bronchial carcinoma or active pulmonary tuberculosis. Calcified primary complexes may render patients more prone to haemoptysis, though the mechanism is in doubt and we have no proof of a causal relation. Systemic hypertension is an uncommon cause of haemoptysis.

In carcinoma, haemoptysis tends to be minimal but persistent; a frank haemoptysis is unusual and the certainty of the haemoptysis may be in doubt. It is still an important and frequent symptom in this disease.

In active pulmonary tuberculosis there is a brisker bleeding of short duration and the incidence of this symptom has declined.

We confirm that the amount of bleeding is no index of the underlying pathology.

Over a two-year period 89.8% of these patients were followed up. So little change was shown that we believe that follow-up is not necessary, provided the patients are carefully assessed at the first examination. In men over the age of 40, in whom the risk of carcinoma is higher, bronchoscopy is an essential part of the initial investigation.

We gratefully acknowledge the help and interest of Professor I. G. W. Hill in the preparation of this paper. We are indebted to Mr. Martin Fallon for details of patients investigated in the regional thoracic surgical unit, and to many practitioner colleagues for help in tracing patients.

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CLINICAL EVALUATION OF PROMAZINE AS AN ADJUNCT TO PREDELIVERY SEDATION

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In recent years little progress has been made in obstetric practice with regard to analgesia and sedation in labour. The principal drugs used universally are still the barbiturates, pethidine hydrochloride, morphine and its derivatives, and scopolamine. None of these, however, satisfies the requirements of the ideal analgesic in obstetric practice. With the advent of the tranquillizing drugs, it was hoped that a new agent might be found which would provide satisfactory neuromuscular relaxation with relief of pain and tension in labour without untoward side-effects on either the mother or child.

Attention was directed to the phenothiazone series because of the potentiating effect of the various compounds in this group on hypnotics and analgesics. The effect of chlorpromazine as a sedative in labour has been reported by several authors (Karp *et al.*, 1955; Anz and Smith, 1956; Schaffer, 1956; Norton *et al.*,